Machine Productivity Improvement of the Test-To-Pack Process Line in the Production of SMD Power Inductors Using DMADV Approach and ProModel Simulation

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Abstract

Machine Productivity is the measuring of a machine's proficiency in converting the raw inputs into a useful product. In the production of surface mount device (SMD) power inductors, machine productivity at the test-to- pack process line is a key performance indicator in a Philippine-based subsidiary of technology leader in diversified power management solutions. The process line is made up of assembly and testing operations with seven (7) inductor test and packing machines with output performance below maximum capability. Since the inductor test and packing machine is completely automated and used for the electronical performance test, appearance inspection and tape and reel packaging of inductor products, the DMADV approach was employed in identifying the machine-based problem and in developing the best solution for machine productivity and overall process line yield. With the aid of the ProModel software application, simulation analysis confirmed that the proposed solution presents machine productivity increases to at least 95% yield meeting the target daily production output of 85,000 inductors per machine and consequently increasing the Rolled throughput Yield (RTY) from 79.82% to 87.31%, addressing the output performance problem of the company.

Keywords
DMADV, Promodel, Simulation, Bowl Feeder, Pick-and-Place

1. Introduction
Product launches for automotive inductors are becoming more common, and suppliers are expanding their current product lines to make them more suited for automotive applications. Production of automotive inductors adopts the Surface-Mount technology (SMT), a method in which the electrical components are mounted directly onto the surface of a printed circuit board (PCB). An electrical component mounted in this manner is referred to as a surface-mount device (SMD) and is tested in the production line to ensure outstanding reliability to reduce failure risks. It is widely believed that integrating the machining process in automation is great to achieve a better result. Usually related to automation are higher production rates and more efficient use of materials, increased productivity, improved safety, better product quality, shorter workweeks for labor, and reduced factory lead times.

Quality and productivity have been viewed as two main indices of company success for many years, particularly in manufacturing industries. Through quality improvement, productivity can be improved. That is, many researchers and managers agree that quality improvement must be accompanied by improved productivity. Errors, rework, and scrapping are thought to have contributed to the decrease in productivity (Deming, 1982). The company delivers electrical products, systems, and services for power quality, distribution and control, power transmission, lighting and wiring products; hydraulics components, systems, and services for industrial and mobile equipment; aerospace fuel, hydraulic and pneumatic systems for commercial and military use; and truck and automotive drivetrain and powertrain systems for performance, fuel economy and safety. The Philippine branch operations include assembly and testing employing seven (7) Test-to-Pack machines (Inductor Test and Packing Machines). Test-to-Pack machine refers to a machine that integrated with the testing station for the devices then after tested, the device was placed in the packaging directly. The Inductor Test and Packing Machine have five stations for testing namely, Polarity Test, LCR Test, DCR Test, IR Test, and lastly, is the Vision Inspection. The Inductor Test and Packing Machine is an automated machine that can help to increase productivity with high stability and good quality inductor devices for automotive parts. For the period January to June 2020, the company's Test-to-Pack Machines productivity was 93.64% versus the target of 95% resulting in a 6-month output loss of 74,250 pieces or 0.07% over the target outputs equivalent to an opportunity loss of US$ 250,965.00. The actual output of the said machines is only 108,852,750 pieces compared to the 108,927,000-target output of the company. The target output is based on the machine's capability that can produce 85, 500 inductors daily per machine. In table 1, the productivity concern is explained by the results of the Vision Test in the following tabulated summary of test results for Seven (7) Inductor Test and Packing Machines from January to June 2020 monthly summary for each machine of test results in the Test-to-Pack Station.

Table 1. Total Summary of Seven (7) Inductor Test and Packing Machines Performance

Summary for (7) seven inductor test and packing machines for the period January to June 2020							
DESCRIPTION	JANUARY (31 days)	FEBRUARY (29 days)	MARCH (31 days)	APRIL (30 days)	MAY (31 days)	JUNE (30 days)	AVERAGE
Polarity Test	96.86%	96.57%	95.14%	94%	91.71%	87.86%	93.69%
LCR Test (T1)	97.29%	97..14%	97%	96.29%	95.86%	94.57%	96.36%
DCR Test (T2)	97.43%	97.29%	97.29%	97%	97%	96.71%	97.12%
IR Test (T3)	97.57%	97%	97.14%	97.14%	97.29%	97.14%	97.21%
Vision Inspection	97.43%	96.71%	96%	92.57%	90.43%	88.71%	93.64%
Target Output	18,553,500	17,356,500	18,553,500	17955000	18,553,500	17955000	108,927,000
Actual Output	18,608,250	17,399,025	18,598,500	17,912,250	18,503,250	17,840,250	108,852,750
							Variance -74,250

Productivity of the Test-to-Pack Process Line is reckoned with the Vision Inspection results as it is the last of the four (4) test process steps done by the machines, hence the output, which must pass all the tests by 95%, is governed by this last process. It was also observed that the Vision Test results started to decline beginning April of 2020. Productivity is classified as outputs ÷ inputs. Productivity increases when the same quantity of input results in more outputs, or when you get the same quantity of output using fewer inputs.

Accordingly, this study sought to achieve the following objectives:

1. To determine the root causes of the non-attainment of the target output by 0.07% that led to an opportunity loss of US$ 250,965 in the first 6 months of the year 2020.
2. To identify areas for improvement of the current Test-to-Pack process line and to address the significant factors affecting its overall productivity.
3. To develop sustainable solutions to improve productivity from 93.64% to at least 95% and rolled throughput yield to at least 85%.

The results of the study would benefit the company in terms of addressing the productivity concerns at the Test-to-Pack process line. The study will also benefit practitioners and researchers to explore other production methodologies and conduct future studies in pursuing leapfrogging productivity performance increases in terms of efficiency, quality, and effectiveness.

The study focused only on the Test-to-Pack modification with Seven (7) Inductor Test and Packing Machines of the company as the major area of discussion as regards productivity since this is an end-process area that affects the order-fulfillment key result area of management. The researcher can provide only 6 months of data when the deterioration occurred, but the study will provide another data from July to December 2020 for the different test results of the Test-to-Pack Machines that will be explained in the discussion. Due to confidentiality concerns, the name of the Philippine-based company will be made anonymous.

2. Literature Review

The Inductor Test and Packing Machine is a complete process machine (Figure 1) where it can place the units (inductors) into Input loader (Hopper and Bowl Feeder), the Hooper and Bowl Feeder has a motor to create a vibration to move the units. On industrial production lines, vibratory bowl feeders are commonly used to feed individual component machine parts for assembly. They are used when small components need to be fed into another one by one in a bulk package that's been randomly sorted and oriented in a certain direction. (Maul, 2008). Bowl Feeder is part of the handling operation or feeding process for automated machines.

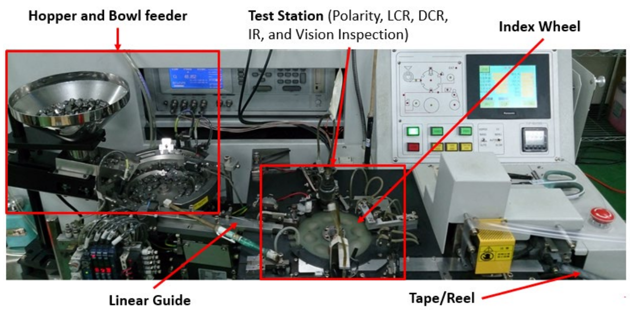


Figure 1. Inductor Test and Packing Machine

Six Sigma is one of the most common method used by companies to improve quality and productivity. One of the most popular business practices currently in use is the Six Sigma approach. Motorola Corporation established this concept in the mid-1980s (Aguado et al. 2013, Albliwi et al. 2015). By recognizing and reducing the causes of defects and reducing effect variability in manufacturing and business processes, Six Sigma methods strive to enhance the productivity and quality of a process (Rodriguez and Sharma, 2007). There are two methodologies for applying Six Sigma. These are DMAIC and DMADV methods, according to Ravi (2013) when an organization is planning new systems to satisfy the demands of its clients, the Six Sigma DMADV approach is used. Carvalho et al. (2009) the DMADV project methodology, known as DFSS ("Design for Six Sigma") features five phases (Define, Measure, Analyze, Design, and Verify). The DMADV methodology used when (1) a product or process does not exist at your company and needs to be implemented, or (2) a product or process does exist and has been optimized (using or not using either DMAIC I) but still does not meet the Six Sigma standard customer specification criteria. Based on Bañuelas and Antony (2003), The DMADV method is used if existing processes need to be redesigned to reduce inconsistency. The application of DMADV is used when the customer or customer needs to develop the product, modify it, or make a completely new product or service.

The DMADV system has a significant advantage over other quality management methods in that it is customer-driven. The aim of the procedure is to maximize customer satisfaction while still increasing profits and lowering defect rates. It's particularly useful in the production of precision products, such as medical instruments, where consistency is important. The power inductors tested in Inductor Test and Packing machines are used for safety features in automotive.

Modification is defined as a change or adjustment, usually to create something work even better. In any manufacturing company, modification is very important, manufacturing is a general term that refers to chemical companies, agriculture, automobiles, clothing manufacturers, newspapers, semiconductors, and many more (Jack, 2013). The proposed solution for the Inductor Test and Packing machine will be to develop a greater performance of the machine and to meet the desire production output and maintain the good quality of the inductors. It is difficult to find the relationship between quality and productivity by their definitions (Lawler and Ledford, (1983), Mohanty and Yadav, 1994). The terms quality and productivity are synonymous by a few researchers. According to Adam et al. (1981), scholars and practitioners sometimes refer to 'productivity' and 'quality as if they were two different indicators of success. But quality is a significant part of any productivity equation. Kaydos (1991), assumes that productivity and quality are nearly identical. Pantera (1985), asserts that the key to productivity is quality. Garvin (1988) also acknowledges that there is a strong connection between quality and productivity. He explained that less rework means more time devoted to manufacturing acceptable products, and less scrap means fewer wasted materials. Through quality improvement, productivity can be improved. That is, many researchers and managers believe that quality improvement must be followed by improved productivity. One of the features of high-performance companies is that "quality enhancement is a catalyst for improving productivity" (Shetty and Buehler, 1985). Hart and Hart (1989) feel that increased productivity would follow with improved quality.

The results of the production time between the current operation and the proposed solution will be presented using simulation software (ProModel) in this study. According to Schriber (1987), simulation of a system or process is the adoption of a model that mimics the real system's reaction to events that take place over time. One of the advantages of simulation in a system is to decreases the probability of systems operation running inefficiently or not meeting minimum output requirements.

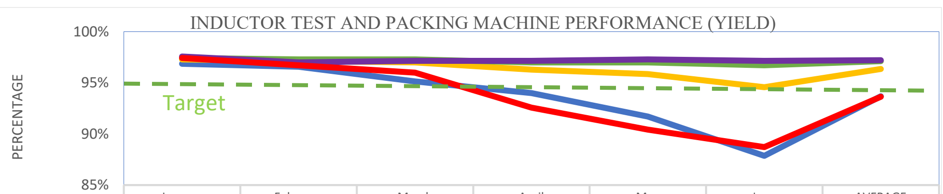
3. Implementing Six Sigma Concepts (DMADV)

The primary objective of this study is to focus on the modification of the Inductor Test and Packing Machines that will create an impact on the production yield and the customer order fulfillment. The methodology of DMADV was designed to establish ways or processes that can efficiently solve and maintain defined problems through standard operations. Sigma's five-stage DMADV method eliminates process, product, or service defects. The most widely used basic analysis and measurement tools are flow charts, Pareto analysis, cause & effect diagrams. Due to its focus on success by comprehensive research, DMADV can be a helpful framework for improving the efficiency, effectiveness, and productivity of the Inductor Test and Packing Machines.

3.1. Define Phase

A Run Chart shown in Table 2 below was used to summarize the performance of the seven (7) Inductor Test and Packing machines for six (6) months. Based on the Run chart, the first three (3) months of the year 2020 showed good performances with all the Test Stations meeting the company target yield of 95%. However, in the succeeding months April to June, the target yield was not met especially for the Polarity Test and the Vision Inspection. This significant drop in the yields of these two (2) stations due to the dirt/dust and scratches found in the Inductors. For the average yield for the past six (6) months only the Polarity Test and Vision Test are mostly affected. Because of the issue of not meeting the target yield of the Polarity Test and the Vision Inspection, the production of the company for the inductors are not aligned with the daily target of 85,500 inductors per machine which equivalent to 598,500 inductors per day for the seven (7) machines. The Company decided to modify the seven (7) Inductor Test and Packing Machines to recover the production of the inductors and to minimize the loss. From July to December 2020, the researcher will provide another data for the seven (7) Inductor Test and Packing Machines to summarize the performances of the machines during the said period.

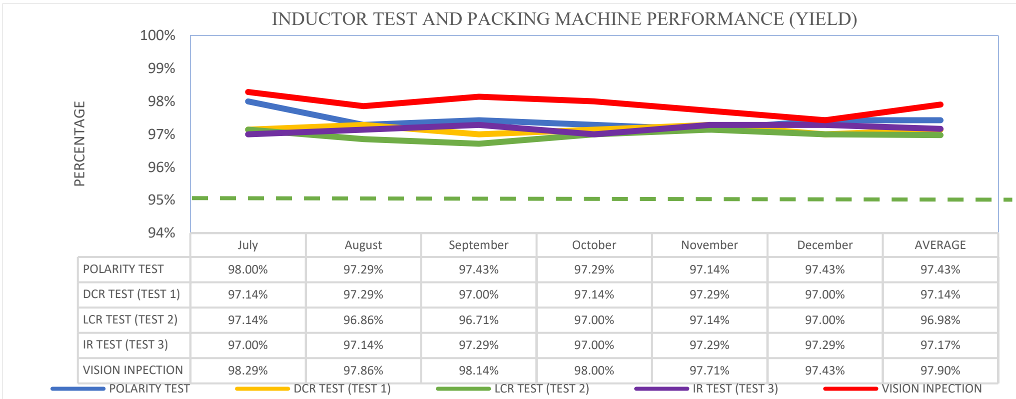
Table 2. Run chart (January - June 2020)



	January	February	March	April	May	June	AVERAGE
POLARITY TEST	96.86%	96.57%	95.14%	94.00%	91.71%	87.86%	93.69%
DCR TEST (TEST 1)	97.29%	97.14%	97.00%	96.29%	95.86%	94.57%	96.36%
LCR TEST (TEST 2)	97.43%	97.29%	97.29%	97.00%	97.00%	96.71%	97.12%
IR TEST (TEST 3)	97.57%	97.00%	97.14%	97.14%	97.29%	97.14%	97.21%
VISION INPECTION	97.43%	96.71%	96.00%	92.57%	90.43%	88.71%	93.64%

Based on the data gathered for this period for July to December 2020, Table 3 showed that the performances of the Seven (7) Inductor Test and Packing Machines were increased and able to meet the company target yield of 95%. The yield in Polarity Test and Vision Inspection were improved from 93.69% and 93.64% to 97.43% and 97.90%. In terms of the machine's performance, the seven (7) Inductor Test and Packing Machines seemingly reached the expectations as far as the yields were concerned. However, the production of the company for inductors was still short for the target output. Table 4 below showed that the seven (7) Inductor Test and Packing Machines still did not meet the production output based on the recorded data for 6 months.

Table 3. Run chart (July - December 2020)



	July	August	September	October	November	December	AVERAGE
POLARITY TEST	98.00%	97.29%	97.43%	97.29%	97.14%	97.43%	97.43%
DCR TEST (TEST 1)	97.14%	97.29%	97.00%	97.14%	97.29%	97.00%	97.14%
LCR TEST (TEST 2)	97.14%	96.86%	96.71%	97.00%	97.14%	97.00%	96.98%
IR TEST (TEST 3)	97.00%	97.14%	97.29%	97.00%	97.29%	97.29%	97.17%
VISION INPECTION	98.29%	97.86%	98.14%	98.00%	97.71%	97.43%	97.90%

Table 4. Total Summary of Seven (7) Inductor Test and Packing Machines Performance

Summary for (7) seven inductor test and packing machines for the period July to December 2020							
DESCRIPTION	July (31 days)	August (31 days)	September (30days)	October (31 days)	November (30 days)	December (29 days)	AVERAGE
Polarity Test	98.00%	97.29%	97.43%	97.29%	97.14%	97.43%	97.43%
LCR Test (T1)	97.14%	97.29%	97.00%	97.14%	97.29%	97.00%	97.14%
DCR Test (T2)	97.14%	96.86%	96.71%	97.00%	97.14%	97.00%	96.98%
IR Test (T3)	97.00%	97.14%	97.29%	97.00%	97.29%	97.29%	97.17%
Vision Inspection	98.29%	97.86%	98.14%	98.00%	97.71%	97.43%	97.90%
Target Output	18,553,500	18,553,500	17955000	18,553,500	17955000	17356500	108927000
Actual Output	18543750	18548250	17952000	18555750	17956500	17361000	108917250
							Variance -9750

Table 4 above also showed the July to December 2020 performance of seven (7) Inductor Test and Packing Machines has produced 108,917,250 inductors only, but the targeted output of the machines which based on the daily target of 598,500 inductors for all machines that will be equal to 108,927,000 for the whole 6 months. Therefore, the period from July to December data was short by 9,750 inductors. The study focused on how to improve the seven (7) Inductor Test and Packing Machines Performance and also to attain the company target production output of inductors.

3.2. Measure Phase

Rolled throughput yield (RTY) is the probability that a defect-free unit will be created by a process with more than one step resulting from the yields of each process step of the whole process (Rolled Throughput Yield, 2013). RTY is a measure of the overall quality level of processes. The RTY of a process is a good indicator of process quality. If the RTY is too low, a problem-solving team needs to investigate how the process can be improved. Table 5, the RTY of the seven (7) Inductor Test and Packing Machines was 80% average. However, after the modification made, the RTY shown in Table 6 was increased to 87.31%. But this increase in the RTY was still not enough to produce more inductors. The company was still looking to achieve both the machine performances and production needs.

Table 5. RTY of Inductor Test and Packing Machines (January- June 2020)

Description	January	February	March	April	May	June	TOTAL
Input	21320194	20312070	22212912	22688250	24662746	25764059	136960231
Output	18608250	17390250	18598500	17912250	18503250	17840250	108852750
Rejected	2711944	2921820	3614412	4776000	6159496	7923809	28107481
RTY (rolled throughput yield)	87.28%	85.62%	83.73%	78.95%	75.03%	69.24%	79.82%

Table 6. RTY of Inductor Test and Packing Machines (July - December 2020)

Description	July	August	September	October	November	December	TOTAL
Input	21032341	21284808	20571046	21293597	20575185	19980646	124737622
Output	18543750	18548250	17952000	18555750	17956500	17361000	108917250
Rejected	2488591	2736558	2619046	2737847	2618685	2619646	15820372
RTY (rolled throughput yield)	88.17%	87.14%	87.27%	87.14%	87.27%	86.89%	**AVERAGE** 87.31%

To understand the Inductor Test and Packing Machines process, the researcher will provide a process flow chart (Figure 2). The Process flow chart of the machines will help to know the direction of the overall process of the machines.

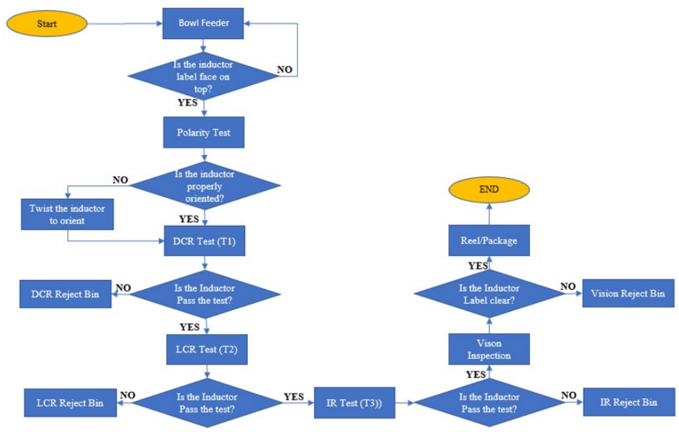


Figure 2. Process Flow Chart of the Inductor Test and Packing Machine

3.3. Analyze Phase

To close the productivity gap, it is important to define the factors and validate the root causes after reviewing the collected data in the previous phase. The root cause analysis tools to be used are Pareto Chart, Fishbone Analysis, and 5 Why's.

3.3.1. Pareto Chart

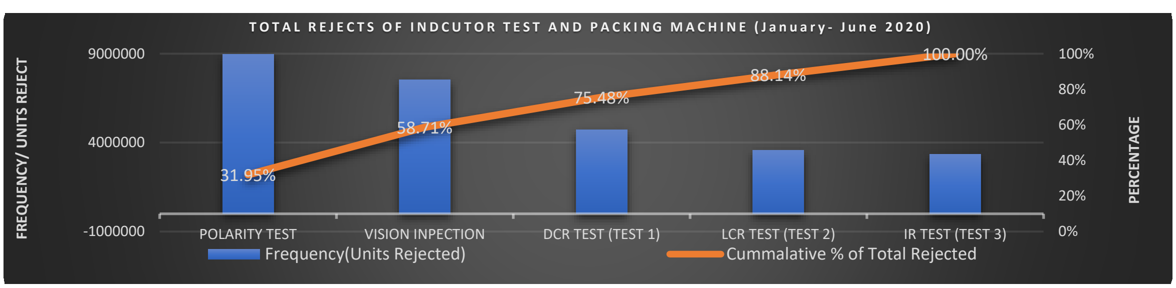


Figure 3. Pareto Chart (January-June 2020)

The Pareto Chart for the data of January to June 2020 in figure 3 shows that the top 2 contributors for the most reject units were the Polarity Test and the Vision Inspection in the Inductor Test and Packing Machines. More than 50% of all total rejects if the Polarity Test and Vision Inspection combined. For the data from July to December 2020, the Pareto Chart was changed (see Figure 4). The Polarity and Vision are fewer contributors for rejects after modification. But the production level still not meeting the target output.

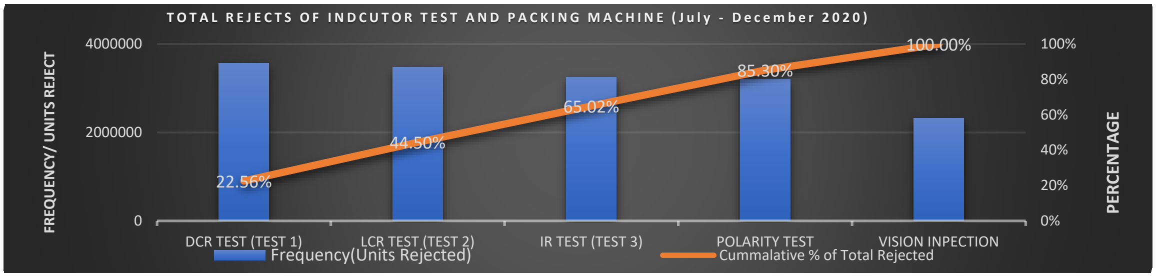


Figure 4. Pareto Chart (July - December 2020)

3.3.2. Fishbone A

The Fishbone analysis will help to identify the contributors of the low production of inductors in the Inductor Test and Packing Machines. The Fishbone analysis presented by the researcher is based on the responses of the persons involved in operating and maintaining the Inductor Test and Packing Machines, these persons are the operators and technicians of the company. In figure 5, it shows that the Machine Parts worn out is the major cause why the production is not attaining the target output of the machines. The major contributor found out in the reject bins, the inductors had scratched and dust which leads more rejects in the Test Stations particularly in the Polarity Test and Vision Inspection.

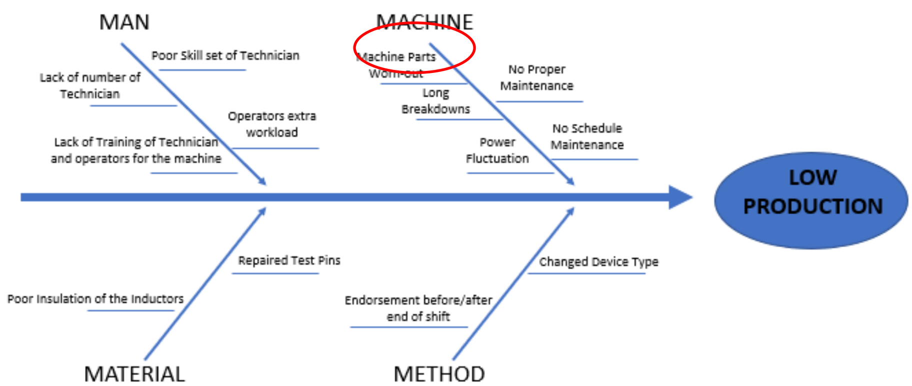


Figure 5. Fishbone Analysis

3.3.3. Five (5) Whys Analysis

After analyzing the root cause, Figure 6 showed that the researcher found out that the Bowl Feeder is the reason why cannot attain the production of inductors. In data from July to December 2020, the company disabled the Bowl Feeder as an input loader of the machine. The operators act as an input loader of the machine to reduce the over-rejection of the machines. However, the modification is still not enough to recover the loss of the company for the low productivity.

For validating the root cause of the problem of the machine, the Equipment Engineer conducted a test run in the machine. The test run will be using a fresh lot or new batch of inductors that are unstarched and no dust/dirt. The 1000 inductors of a new batch are placed in the cleaned Bowl feeder in the machine to run. This run of the machine will verify for the inductors in the reject Bins if it's contaminated with dust/dirt and if it has a scratch during the operation. The below is sample units in the reject bins of Polarity Test and Vision Inspection. Only Polarity Test and Vision Inspection are being checked because these two (2) Stations are among the biggest contributors to the low productivity and poor quality of the machine. In figure 7, the inductors from the reject bins are having scratches and dust/dirt after the test run in the machine. The reject inductors in Polarity Test are because of the dust/dirt caused by the Bowl feeder and being in a centralized location of the machine, the sensor in the Bowl Feeder can't detect accurately the acceptable orientation. In Vision Inspection the inductors found that the scratches and the dust are the cause of the rejection of the Vision Test because the camera can't read clearer the label marking of the inductors.

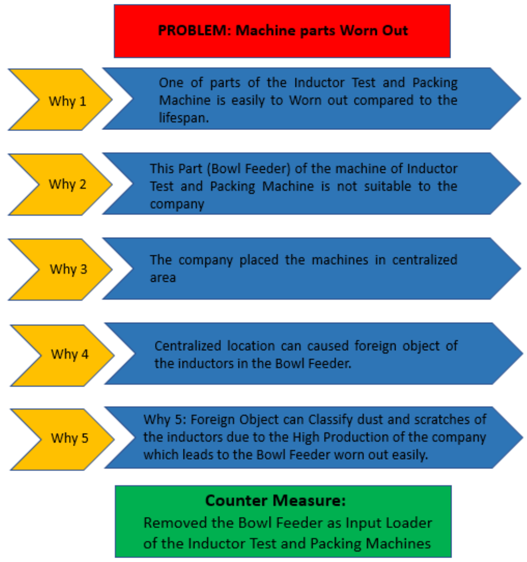


Figure 6. Five (5) Whys Analysis

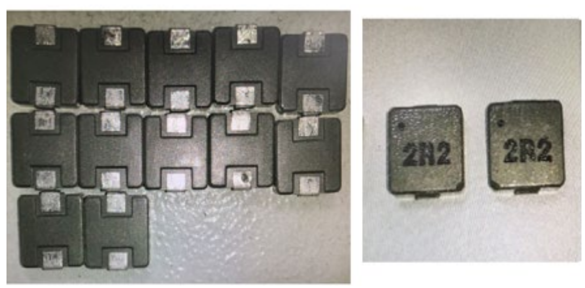


Figure 7. Inductor rejects

3.4. Design Phase

In design phase will provide a system design for the replacement of the Bowl Feeder. The suggested solution can improve the machine's performance and increase the production output and at the same time to maintain the quality of the inductor to lessen the dust, and scratches made by the feeder bowl, and the solution is the Pick-and-Place method. In figure 8, the AutoCAD application will be used to create a design for the Pick-and-Place. The purpose of the AutoCAD design is to give the company visualization of the proposed solution. The researcher will create also a prototype of the suggested solution to measure the movement of the arm of the pick and place. The travel time of the Pick-and-Place will be used in the Promodel simulator. The average of the simulation of the prototype of the Pick-and-Place was 3.5 seconds from picking the inductors in a tray until placing them in the linear guide.

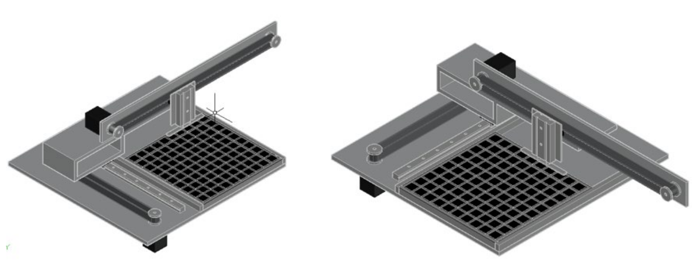


Figure 8. Pick-and-Place Design

3.5 Verify Phase

To verify the proposed solution if its relevant to improve the Inductor Test and Packing Machines performance and to increase the production, the Promodel application will simulate the Pick-and-Place solution. Also, the researcher will compare the Bowl Feeder, manual operations (operator act as input loader), and the Pick-and-Place. The comparison will be based on how many minutes to finish the one reel.

The first to simulate is the Bowl Feeder, in figure 9 (a) is the process or the procedure of the machine movement and it indicates the yields of the test stations. Those yields will use in ProModel as a probability. The yield was based on Table 1 where the data is from January to June 2020. While figure 9 (b) is the result of the simulation of the Inductor Test and Packing Machine using Bowl Feeder.

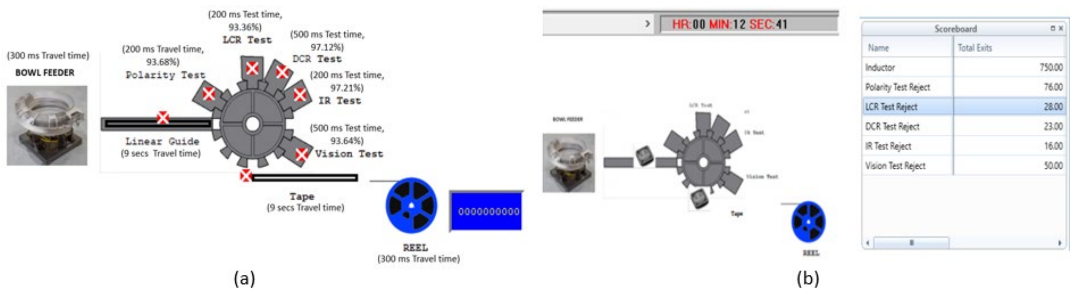


Figure 9. Simulation of the Inductor Test and Packing Machine using Bowl Feeder Method

The next simulation is the modified Inductor Test and Packing machine using the operators to acts as input loader. The operator will use a long stick (made of a magnet) to pick the 10 units at the same in the Tray then will place the units in the linear guide. The data that is used is from July to December 2020. The yield was based on Table 5. In figure 10 (a), is the process or the procedure of the machine movement. It indicates the travel time, test time, and the yields of the machines. Figure 10 (b) is the result of the simulation of this method.

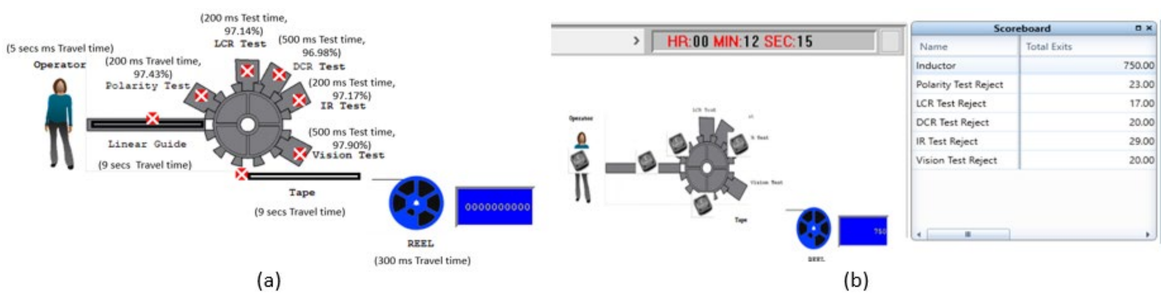


Figure 10. Simulation of the Inductor Test and Packing Machine using Manual Operation Method

The last to simulate is the proposed solution which is the pick-and-place. Since this is still a suggestion solution, the simulation will copy the yields of the operator. The researcher believed that the operator solution and the pick-and-place solution will have identical yields of the Inductor Test and Packing machines. Because the operator is placing the inductors in the linear guide, same with the pick-and-place solution where the inductors pick from the tray and it placed in the linear guide. The handling of the inductors to travel from one place to another are smooth compared to the feeder bowl where the inductor can build dust and scratches. In figure 11 (a), indicates the travel time, test time, and yields of the machines. Figure 11 (b) shows the result of the simulation of the proposed solution to improve the machine performance at also to increase the production output.

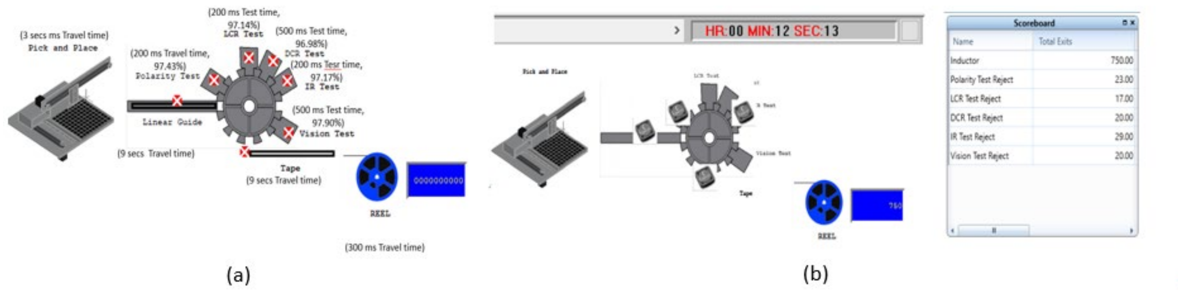


Figure 11. Simulation of the Inductor Test and Packing Machine using Pick-and-Place Method

Table 7. Summary for the Simulation

Method	Time	Daily Output/Machine	Rejects
Bowl Feeder	12 minutes and 41 seconds (761 seconds)	85, 151 inductors	195
Manual Operation	12 minutes and 15 seconds (735 seconds)	88, 163 inductors	109
Pick-and-Place	12 minutes and 13 seconds (733 seconds)	88, 404 inductors	109

Table 7 is the summary of the simulation. For the Bowl Feeder, this method can finish the 1 reel in 12 minutes and 41 seconds. The output of 1 machine for a day can provide 85, 151 inductors. This means that the Bowl Feeder method cannot meet the daily target of 85, 500 inductors because the yields on the Test stations are not good. The computation for daily output is to divide the 86, 400 seconds (86, 400 is equivalent to 24 hours) to 761 seconds then the result will be multiplied to 750 inductors in a reel. For manual Operation, as you can see the daily output can produce 88, 163 inductors because the yields of all stations were above 95%. But in actual this is hard to achieve because the operators are also having other duties to do during the shift, like encoding and barcoding the finished product in the system. This means that the operator cannot sustain the 5 seconds movement by picking and placing the inductors in the machine consistently. The Pick-and-Place method is the best solution to achieve the 85, 550 inductors per machine. Although the Pick-and-Place solution is still needed to replace the tray when there are no more inductors. Operators still need to change the tray to continue the operation, but the replacement of the tray is enough to buy time for the operator to do other duties such as encoding the finished product into the system.

Overall, the Pick-and-Place method can provide the product demand to reach the 85,500 inductors a day and to improve the performances of the machines by increasing the yield of all Test Station to 95% above and also to attain the RTY of 85% of the company.

4. Conclusion

The study used the DMADV method to find the root cause why the Seven (7) Inductor Test and Packing Machines cannot meet the target output of the company and the decreasing of the performances of all the machines for not able to achieve the minimum requirements for the Yields of all the test stations at least or above 95% and the RTY (Rolled Throughput Yield) at least or 85%. After identified the root cause was the Bowl Feeder, Bowl Feeder is one of the parts of the Inductor Test and Packing Machine. The original design of the machines was excellent for this kind of process where the productions are a bulk package of small components. However, this kind of input loader (Bowl Feeder) is not suitable for this particular company where the production location was centralized, and the materials used for Bowl Feeder were easy to worn-out. The provided solution for this study is to modify the machines and replaced the Bowl Feeder with the Pick-and-Place method that will help the company to achieve the objectives to eliminate the production loss, also as to increase and meet the production output of 85, 500 inductors daily for each machine. Therefore, using the Pick-and-Place method can improve the machine's performance to reach the requirements to attain the 95% yields of all the Test Station and for the RTY (Rolled Throughput Yield) at least or beyond 85%. The purpose of the Pick-and-Place as the input loader for the Inductor Test and Packing Machines is to minimize the scratches and dust if not eliminated in the inductors to maintain the quality of the product of the company.

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